REMARKS

The above amendment with the following remarks is submitted to be fully responsive to the Official Action of June 10, 2004. Reconsideration of this application in light of the amendment and the allowance of this application are respectfully requested.

Claims 4, 5, 8 and 9 stand allowed. The Examiner's indication of allowed subject matter is appreciated.

Claim 6 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Chang et al. in view of Hsu et al. Also, claim 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Chang et al. in view of Hsu et al. and further in view of Konecni et al. By this amendment, independent claims 6 and 10 have been amended to clarify the present invention over the prior art of record. As a result, for the following reasons, it is respectfully requested that newly amended independent claims 6 and 10 are not obvious in view of the prior art of record.

The present invention as recited in newly amended independent claim 6 is directed to a method for fabricating a gate electrode structure which includes forming, between a silicon-containing film and a metal film with a high melting point, a barrier metal layer of titanium nitride rich in titanium as compared with a stoichiometric ratio, wherein the barrier metal layer is a diffusion preventing film for preventing impurities introduced into the silicon-containing film from diffusing to the metal film with a high melting point. Newly amended independent claim 10 is directed to a similar method which includes forming, between the silicon-containing film and the metal film with a high melting point, a first barrier metal layer of titanium nitride rich in titanium as compared with a stoichiometric ratio, and forming, on the first barrier metal layer, a second barrier metal layer of titanium nitride including nitrogen in a ratio not less than a stoichiometric ratio, wherein the first barrier metal layer and the second barrier metal layer are diffusion preventing films for preventing impurities introduced into the silicon-containing film from diffusing to the metal film with a high melting point. In this manner, the present invention prevents the impurities included in the silicon-containing film from diffusing to the metal film with a high melting point. Thereby, the present

invention prevents the forming of a suicide layer due to a reaction between silicon of the silicon-containing film and the metal with a high melting point.

The combination of Chang et al. and Hsu et al., and the combination of Chang et al., Hsu et al. and Konecni et al., fail to render obvious the present invention as recited in newly amended independent claims 6 and 10, respectively, for the following reasons. Chang et al. admittedly teaches a method for forming a gate electrode, as shown in Figs. 1a-1d, including a step of sequentially forming, on a gate oxide layer 2, a polysilicon layer 3, a TiN layer 4 serving as a barrier metal layer, a W layer 5, a SiN layer 6 and a BARC layer 9 services as an anti-reflection layer. Subsequently, after forming a resist patter 10 on the BARC layer 9, a stacked layer is formed by dry etching the SiN layer 6, the W layer 5 and the TiN layer 4, and a second SiN layer 11 is deposited thereon. Thereafter, space portions 11 of the SiN layer is formed on the sidewalls of the stacked layer by anisotropic etching, and a gate electrode L1 is then formed by dry etching the polysilicon layer 3 using the SiN layer 6 and the space portions 11 of the SiN layer as a mask. Hsu et al. also admittedly teaches a method for forming an aluminum interconnect, as shown in Figs. 4-5, including a step of forming a two-layered anti-reflective layer composed of a Ti rich TiN layer 24a and a substantially stoichiometric TiN layer 24b on an A1 conductor layer 22, and forming a resist pattern 26 thereon. Thereafter, an A1 interconnect 22 is formed by dry etching the above multiple layers. In other words, the TiN layers 24a and 24b on the A1 interconnect 22 are both anti-reflective layers. Moreover, since the ratio of the substantially stoichiometric TiN layer 24b is $1.0 \leq Ti/N \leq 1.1$, the two layers of anti-reflective layers are Ti rich TiN layers. That is, Hsu discloses a Ti rich TiN layer which is an anti-reflective layer. On the other hand, the Ti rich barrier metal layer of the present invention is a diffusion preventing film for preventing impurities introduced into the silicon-containing film from diffusing to the metal film with a high melting point. Chang et al. and Hsu et al. both fail to disclose the important feature of independent claim 6 wherein the barrier metal layer is a diffusion preventing film for preventing impurities introduced into the silicon-containing film from diffusing to the metal film with a high melting point. Moreover, there is absolutely no motivation to combine Chang et al. and Hsu et al. in a manner so as to arrive at the present invention having this feature. A person of ordinary skill in the art would not be motivated in combining Chang et

al., which discloses using a TiN layer as a barrier metal layer, and Hsu et al., which discloses using a TiN layer as an anti-reflective layer, and further would not be motivated to combine these references in a manner to arrive at the invention as claimed in newly amended independent claim 6. Thus, it is respectfully submitted that newly amended independent claim 6 is patentable over the combination of Chang et al. and Hsu et al.

With respect to newly amended independent claim 10, Konecni et al. fails to make up the shortcomings of Hsu et al. and Chang et al. Konecni et al. admittedly teaches a method for forming a W plug, as shown in Figs. 5-7, including a step of sequentially forming, on a Si substrate 10, a Ti layer 16 serving as an adhesion layer, a high density TiN layer 18 serving as a first barrier metal layer and a high density TiN layer 20 serving as a second barrier metal layer, after forming a contact opening 14 in a dielectric layer 12. Thereafter, a W conductive layer 22 is formed thereon, and a W plug 22 is formed by dry etching. Hence, the combination of the two high density TiN layers 18 and 20 serves as a barrier for the etching process of W. Thus, Konecni et al. merely discloses a barrier metal layer composed of two high density TiN layers, but completely fails to disclose the ratio of titanium and nitrogen in a two-layer TiN film. A person of ordinary skill in the art would not be motivated to combine Chang et al., Hsu et al. and Konecni et al. in a manner so as to arrive at the present invention of newly amended independent claim 10 when these references simply fail to disclose all the elements of independent claim 10, and further fail to suggest any motivation for combining the references in a manner so as to arrive at the invention of claim 10. Thus, it is respectfully requested that independent claim 10 is unobvious over the combination of Chang et al., Hsu et al. and Konecni et al.

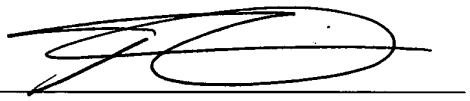
Accordingly, reconsideration and withdrawal of the rejections of independent claims 6 and 10 under 35 U.S.C. §103(a) are in order and respectfully requested.

New claims 11-14 are hereby added to more completely protect Applicants' invention. Specifically, dependent claims 11 and 13 are directed to the step of patterning the multi-layer film including a sub-step of patterning the silicon-containing film and the metal film with a high melting point into an equal pattern size. It is noted that Chang et al. merely discloses a pattern size of polysilicon layer 3 of the gate electrode L1 which is larger than the pattern size of the W layer 5. Hence Chang et al. fails to disclose a silicon-containing film

and a metal film with a high melting point having an equal pattern size. Dependent claims 12 and 14 are directed to the method wherein the ratio of nitrogen (ratio of N/Ti) included in the barrier metal layer is approximately 0.7. In Hsu et al., since the ratio of the Ti rich TiN layer 24a is $1.1 \leq Ti/N \leq 1.2$, or in other words $0.83 \leq N/Ti \leq 0.91$, Hsu et al. fails to disclose the present invention of dependent claims 12 and 14. Thus it is respectfully requested that newly added claims 11-14 are allowable over the prior art of record for these reasons and at least in that they depend from newly amended independent claims 6 and 10.

In view of the foregoing, it is submitted that the present application is in condition for allowance and a notice to that effect is respectfully requested. However, if the Examiner deems that any issue remains after considering this response, he is invited to call the undersigned to expedite the prosecution and work out any such issue by telephone.

Respectfully submitted,



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